

Capturing Clinical Reports in a Large Academic Medical Center: Feeding a Central Patient Data Repository

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ABSTRACT

Clinical reports, notes, and other narratives are highly used components in the patient record. Unfortunately, the methods by which these reports are generated are as diverse as the fiscal autonomy of academic clinical departments in a university-based health science center. In this paper, we report on electronically capturing clinical reports, notes, and other text fragments from several hospital sources and many outpatient clinics. The purpose of the capture is to feed the ACIS (Advanced Clinical Information System) central patient data repository that is in use at the University of Utah Health Sciences Center (UUHSC).

A survey conducted in early 1994 indicated that about 917,150 reports were generated per year at UUHSC representing about 1.2 million pieces of paper, occupying about 2.3 gigabytes of storage. The most crucial problem encountered in capturing the reports was linking them to the proper patient. Systems that had functioning and well-maintained admit-discharge-transfer (ADT) information performed well, but systems that relied on the human dictator to identify patients, produced patient linkage errors. In our open loop telephone dictation systems this error rate averaged between 6 and 10%. Subsequent to the wide-spread availability of clinical reports on ACIS, this error rate dropped to 3-5%, presumably due to increased demand for on-line availability of this information. From clinical secretaries who use their word processor to create the clinical reports, the linkage error rate was <1% due to the use of our Advanced Text Upload (ATU) utility.

The clinical text component in ACIS contributed significantly to the success of a JCAHO site visit in December 1995.

INTRODUCTION

The generation and recording of unstructured, free text information (hereafter called "Clinical Reports") is a fundamental activity¹⁻⁴ of the patient care process. Every healthcare provider spends a considerable amount of time and effort in the creation, proofread-

ing, recording, and signing of these reports. Additional time and energy is expended by support staff to organize, store, retrieve, copy, and disseminate these paper-based documents.

While nearly all clinical reports are kept as paper documents, many of them exist in electronic form at some point during their lifetime. An informal survey⁵ conducted at the UUHSC gave us preliminary estimates of the sources, types, volume, and storage of these clinical reports. This survey suggested that capturing these clinical texts in their digital form would greatly enhance the value of ACIS⁶.

METHODS

The UUHSC is comprised of a 480-bed tertiary care hospital, about 27 out-patient clinics, and several special clinical laboratories managed by various entities within the Hospital or the School of Medicine.

Survey of the Generation of Clinical Reports, Notes, and other Text Fragments

The survey was based on unstructured telephone interviews with departmental managers who use the patient charts and understand how the various pieces are generated, processed, and disseminated. Both administrative and clinical staff were contacted in order to ascertain all information. Usually, the administrative staff has knowledge about the volume (i.e., number of reports) and the clinical staff about the type, length, and size of the reports. The survey included only reports from the originating sources. An exception was the Department of Health Information (HI) which provides transcription services to the providers in the hospital for discharge summaries and operation reports. Special care was taken to avoid double counting.

Discharge Summaries and Operation Reports

To capture the discharge summaries and operation reports, we coordinated our efforts with HI and a large national transcription service (LTS) which provides all transcription for discharge summaries and operation reports in the hospital. LTS uses their own telephone dictation system and a text server for managing the transcribed reports. Both systems are lo-

cated in the LTS business office in Salt Lake City. The doctors use the telephone to access the dictation system, enter their provider number, report type (operation report, discharge summary, etc.), and the medical record number (MRN), all via the touch pad. The dictation system creates a record and attaches the digitized dictation. No on-line verification of information provided by the dictator is made at this time.

LTS transcriptionists dial into the dictation system, transcribe the dictation on PCs, and upload the reports to the text server at LTS. After a quality review, the reports are uploaded to the HI document management system (DMS). HI staff monitor this process, print-out paper copies, seek physicians for signatures, and file the reports in the patients' charts. A program, on a dedicated PC, monitors the DMS for new or revised reports and creates HL7 messages that are stored in a special directory. An ACIS gateway⁶ picks up these HL7 messages and feeds them to ACIS.

In order to reduce the number of reports that could not be linked to an ACIS patient, a daily error list was printed for the HI Department. For example, if the MRN was not valid, the process would take parts of the first and last name and "suggest" possible patients for the match. If the MRN existed in ACIS and the name did not agree, the error report showed possible choices including the sex, DOB, and admission dates. This simplified the process for HI staff to correct the errors in the DMS and a revised report would be sent to ACIS automatically.

Radiology Reports

Our radiology information system, IDXrad, has an integrated dictation solution consisting of a Lanier dictation system and PC-based transcription workstations. IDXrad controls the dictation process. It starts with a requisition for a radiology service and ends with an HL7 message sent to ACIS. In between, IDXrad keeps track of the dictation process using special hand-held microphones with a bar-code reader and keypad. The bar-code reader is used to wand the requisition sheet to identify the patient and associated films, the key-pad is used to identify the radiologist. The combination of bar-coding and on-line physician data entry allows for the creation of filled-in report templates for each dictation. These report templates are then completed by in-house transcriptionists and the resulting report is uploaded to IDXrad where the physician can read, edit, and sign the reports electronically. A process within the IDXrad system sends HL7 messages to the ACIS gate-

way. From there, the reports are uploaded into ACIS.

Notes from Outpatient Clinics

The capture of outpatient clinic notes is discussed according to their mode of report creation and text generation: transcription by local companies, transcription by clinical secretaries, and direct keyboard data entry by providers. These three modes represent the current approaches used at UUHSC.

Local Transcription Companies. Most local transcription companies are small enterprises employing 2-10 transcriptionists. In general, these companies are unfamiliar with the HL7 message standard but are willing to up-load the transcribed reports to a NT Server using Point-to-Point Protocol (PPP) dial-up networking native to Windows 95. Each report is sent as an individual file which must include a header to identify the patient, dictator, clinic, report type, and visit date. This information is used to link the report to a specific patient and visit in ACIS. If there is a problem with the structure of the file header, the report is not processed but moved to an error sub-directory. If the header is structurally acceptable, it is then sent to ACIS where the accuracy of the header data is validated. If errors occur at either of these stages, staff must correct these errors.

In order to keep the linkage error rates low, the clinic generates a dictation worksheet for each patient visit that includes the patient name, medical record number, visit number, clinic name, provider, and visit date. This worksheet is picked-up by the transcription company together with the analog voice tapes and used to accurately identify the patient in the header record. The same worksheet is also used by the providers during the patient encounter to record reminders or short notes for their subsequent dictation.

Clinical Secretaries. The secretary's PC must be networked and allow for the installation of the Advanced Text Upload (ATU) utility. The ATU utility has two components: a word processor-specific module and a document-submittal module. In the case of WordPerfect or Word, the word processor-specific module is a macro designed specifically to output the report in a proper format for submittal to ACIS. This first module appears as a "submit" button to the secretary. The button actually stores the file in a "submittal-ready" queue (local holding directory). At the end of the day, the ATU program (module 2) is started showing all reports stored for submittal. Via a live query to ACIS, each report can be assigned a patient, visit date, document type, physician, etc. and

uploaded to ACIS. Experience has shown that a secretary only has to select the patient and the service date, because work type, provider, and clinical specialty remain fairly constant. Staff also uses this mode of report capture as well as secretaries of special clinical laboratories for echocardiography, EEG, sleep studies, etc.

Direct Data Entry by Providers. The ACIS Chart program is the basic tool used by providers to retrieve and enter patient information. It is based on the "index tab" metaphor, i.e., a series of tabs at the bottom of the screen allowing the provider to access a patient selection screen. Once a patient has been selected, the following "tabs" become active: Visit, Cover, Allergies, Problems, Medications, Laboratory, Documents, and Radiology. These tabs represent major sections in the ACIS patient record, all of which may contain free text data. Within the "Visit" tab, for example, individual visits can be selected whereupon the visit note is displayed. For a new visit, a button allows the user to enter text directly into the note field.

RESULTS

Clinical Report Survey

The results of the survey are based on information provided by 36 divisional managers in 13 departments. In total, the survey represents about 917,150 clinical reports per year having a total of approximately 1.2 million pages or about 2.3 billion characters. In terms of the number of reports, about one third (308,900) are available on a system (e.g., IDXrad, CernerLab), one-third (299,550) are available on a networked PC, and one third (308,700) are available on paper only. However, in terms of character counts, the system category accounts for forty percent (946 Mb), the PC category accounts for thirty seven percent (853 Mb), and the paper category accounts for twenty three percent (532 Mb). The paper category includes sub-categories such as externally transcribed notes that are faxed to a clinic (56,000 or 199 Mb), pages typed on standalone PCs (72,000 or 207 Mb), machine-generated reports (10,400 or 21 Mb), and hand-written notes (170,300 or 105 Mb). Only the hand-written notes cannot be captured electronically yet. While there are many of them (about 19% of all reports), they account for only 4% of the total character count.

Discharge Summaries and Operation Reports

The HL7 feed from the DMS to ACIS functioned; however, approximately 10% of the reports could not be linked automatically to a patient in ACIS initially.

These linkage problems were primarily due to errors in the MRN or the spelling of the patient's first, middle, or last name. Additional errors, not discussed here, relate to improper identification of dictators, attending physicians, report types, or missing components within a report (e.g., discharge diagnosis).

HI staff used the daily error list to help identify patient linkage problems in the reports. Initially, valiant efforts were made to correct the data. Unfortunately, the errors continued to accumulate faster than available staff could manage. After approximately four months, a weekly report of outstanding errors along with possible corrections was generated. As the staff had time, they worked on cutting that list down to size; however, they never caught up with the current errors enough to move on to older ones. After nine months of weekly reports, they asked us to stop the feedback completely.

Radiology Reports

The HL7 feed from IDXrad to ACIS worked well with a report-patient linkage error rate of less 1%. Most of these MRN errors were associated with temporary MRNs assigned in the emergency room. Although these temporary MRNs are valid, they are not fed to ACIS and therefore failed to match.

Notes from Outpatient Clinics

Many outpatient clinics at the UUHSC pride themselves in maintaining very legible paper records. Some departments retype all hand-written notes and add them to the proper page location by retyping the page or using 'sticky' paper. There are many methods to generate clinic notes. The most common are contracting with local transcription companies or using clinical secretaries, as described below.

Local Transcription Companies. The patient linkage error rate for local transcription companies using couriers to pick-up analog voice tapes dropped from 10% to 2% after we introduced the concept of a dictation worksheet. Local transcription companies that use voice recording over the telephone use a clinic staff member and the ATU utility to upload the reports into ACIS. Their patient linkage error rate is the same as that of a clinical secretary (see below).

Clinical Secretaries. The process of submitting reports has been absorbed into the secretaries' day-to-day routine. We have found that for every 20 reports submitted, a secretary will spend 15 minutes in the patient identification process. This time expenditure, however, results in a big payoff in data availability and timeliness. During the past 10 months, when 9,823 reports were submitted by clinical secretaries,

only 37 (0.3%) resulted in error. In all cases, the errors were attributable to technical mishaps or bugs in the ATU program itself. Utilizing clinical secretaries also had the additional benefit of detecting other errors. For example, secretaries made several requests for corrections in ACIS over the same 10-month period. These requests included the discovery of patients with multiple MRNs (a serious problem), invalid visits, and incorrect patient demographic data.

Direct Data Entry of Notes by Providers. In general, we find that short notes will be entered directly by most providers if clinic policy is established. Those who are proficient in typing will adopt to this mode quite readily. In two of our paperless clinics (i.e., where ACIS is their only patient record), nurse providers maintain the patient record interactively with the exception of the long notes, which they are allowed to dictate. We have found that data entry by physicians varies dramatically from no direct data entry of any kind (not even one-line text fragments) to exhaustive entry of several pages of text. Some providers have even developed their own word processor templates to increase their efficiency. There have even been requests for spell checkers—a definite sign of direct data entry into ACIS by providers.

DISCUSSION

From our initial survey we were surprised to find that only about 4% of the total character count was recorded by hand (19% in terms of number of reports). This suggests that with proper access to and availability of ACIS (and perhaps a few data entry clerks) the balance of clinical free text data could be captured electronically. There is still a sizable paper flow generated by faxes, diagnostic equipment (e.g., ECG machines), and standalone PCs, but this flow could be captured electronically. Finally, small-scale document scanning could eliminate the remaining pieces of paper.

Electronic capture of clinical reports in parallel with a paper-based patient record system clearly shows that paper-based systems have problems that are either unrecognized or ignored due to resource limitations. Our initial finding that about 10% of the discharge summaries and operation reports had the wrong MRN or errors in the patient name was certainly a concern. However, we assume that clerical and clinical staff overcame these deficiencies by correcting the information on the paper and filing the reports in the correct patient chart. Concomitantly, the paper-based chart is still recognized as the official record at UUHSC. This is a classic example where

back-end quality control is expensive and not very effective.

While the initial error rate was 10%, the current error rate has dropped to about 3-5%. Furthermore, when we commenced this project, 3 out of every 10 MRN errors could be classified as nonsense numbers (e.g., 88888888). These nonsense numbers have virtually disappeared. We believe this is due to a greater cognizance of the importance of identifying patients during dictation, better training of the dictators, and a greater demand of having the clinical reports on-line in ACIS.

With LTS, transcriptionists can be located anywhere in the country. This has advantages when transcriptionists with special professional expertise are needed. However, there are disadvantages in that these transcriptionists never “get to know their doctor.” With the smaller local transcription companies, such a relationship can be formed where the transcriptionists learn many idiosyncratic attributes of “their doctor.” Of course, the closest relationships can form, when a physician and a clinical secretary form a doctor-secretary-patient team (or, with the inclusion of nurses, a “doctor-nurse-secretary-patient” team). Frequently, the secretary not only transcribes the dictation, but also schedules the patient for the appointment. In short, the doctor can be very casual in the dictation of patient identification, because the secretary knows the patient and will correct errors automatically.

Our experience with capturing clinical documents from in-house clinical secretaries shows that the quality of patient linkage is very high. Pushing data verification as close to the source as possible, where the knowledge about the patient and the provider resides, clearly improves the quality and the timeliness of the clinical reports. Importantly, the additional cost for this improved quality of service is quite low.

Our experience with direct data entry of clinical notes has been mixed. We have nurses and physicians who enter all their short notes directly into ACIS. We even know physicians who type entire patient histories and physical examinations using templates. These providers are exceptional; the most common argument we hear is: “The computer slows me down.”

ACIS was designed for providers to maintain three elements of the patient record on-line: problems, medications, and allergies. Given the magnitude of the patient-linkage problem, we suggest that the very

short progress notes also be maintained on-line. Eventually, we hope that speech recognition⁷, handwriting recognition, and other tools will be sufficiently mature that healthcare providers will be able to rapidly enter data on-line. Clearly, administrative pressures to see more patients per day while reducing support personnel in the clinics at the same time, discourages physicians and nurses to enter data directly.

Feeding clinical reports, notes, and other narratives to the ACIS central patient data repository contributed to the successful visit of the JCAHO (Joint Commission on Accrediting Healthcare Organizations) in December 1995 where the UHSC reached full compliance in the 'Management of Information' category.

ACKNOWLEDGEMENTS

We would like to thank the University of Utah Health Sciences Center for funding this project. Jim Livingston, Anne Shulick, Qikang Sun, Bo Lu, Mike Baza, Patty Kaller, Al Tokunaga, Di Guo, Ray Aller, Robert Hausam, and Bruce Bray offered valuable contributions, insights and support. Last but not least, we must thank the staff, nurses, and physicians in the hospital and clinics who provided valuable feedback and endured the experiments. We also thank the staff of the participating transcription companies for their cooperation.

References

1. Barnett GO. The Application of Computer-Based Medical Record Systems in Ambulatory Practice. *New Engl J Med.* 1984;310:1643-1650.
2. O'Dell DV, Tape TG, Campbell JR. Increasing Physician Acceptance and Use of Computerized Ambulatory Medical Record. In: Clayton PD (ed.) *Proc. 15th SCAMC 1991*, pp. 848-852.
3. Campbell JR. An Ambulatory Information System Serving the Needs of Clinical Practice: COSTAR V. In: Orthner HF (ed.) *Proc. 10th SCAMC 1986*, pp. 141-146.
4. McDonald CJ, Tierney WM, Martin DK, Overhage JM, Day Z. The Regenstrief Medical Record: 1991 A Campus-Wide System. In: Clayton PD (ed.) *Proc. 15th SCAMC 1991*, pp. 925-228.
5. Orthner HF. Clinical Reports at the University of Utah Health Science Center: An Informal Survey of the Generation of Clinical Reports, Notes, and other Text Fragments. Department of Medical Informatics, University of Utah Health Sciences Center; March 8, 1994, pp. 1-36.
6. Warner HR, Guo D, Mason C, Livingston J, Bray BB. Enroute Toward a Computer-Based Patient Record: The ACIS Project. In: Gardner RM (ed.) *Proc. 19th SCAMC 1995, (JAMIA Symp. Supplement)*, 1995, pp. 152-156.
7. Wormek AK, Ingenerf J, Orthner HF. SAM: Speech-Aware Applications in Medicine to Support Structured Data Entry. In: Masys D. (ed.) *Proc. 21st SCAMC 1997. (JAMIA Symp. Supplement)*, 1997 (these proceedings).